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TI Copper-nickel-silicon alloys having good solder adhesion, coatability, and easy pickling properties and their manufacture
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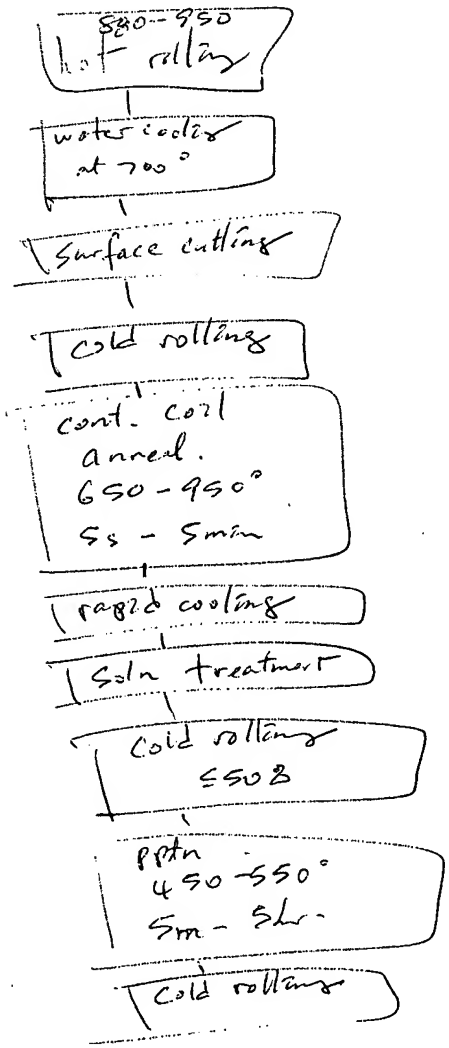
AB The **Cu** alloys contain **Ni** 0.4-4.0, **Si** 0.1-1.0, Zn >1.0 and ≤2.0, Cr 0.0001-0.01, Mg 0.0001-0.001, and optionally Mn 0.01-0.1, Al 0.0001-0.01, Ca 0.0001-0.0005 and/or Sn 0.2-2.0 weight% and comprise **pptd**. Ni2Si having grain size ≤10 nm and ≤10 ppm S as an impurity. The alloys are manufactured by hot rolling of **Cu** alloy ingots at 880-950° to 15 mm thick, water cooling at 700°, surface cutting, **cold** rolling to ≤1.5 mm thick, continuous annealing of coils at 650-950° for 5 s to 5 min, rapid cooling for **soln**. treatment, optional **cold** rolling for draft ≤50%, **pptn**. at 450-550° for 5 min to 5 h, and optional **cold** rolling. The alloys are especially suitable for use in electronic parts.



Notes:
1. Untranslatable words are replaced with asterisks (****).
2. Texts in the figures are not translated and shown as it is.

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FULL CONTENTS

[Claim(s)]
[Claim 1] The copper alloy in which washing is [excelling in the solder adhesion and metal-plating nature which are characterized by the following] easy nickel: 0.4-4.0 weight %, Si:0.1-1.0 weight %, Zn : Exceeding 1.0, -2.0 weight %, Cr: 0.0001-0.01 weight %, Mg: Accept 0.0001 to 0.001 weight %, and the need, and they are Mn:0.01-0.1 weight % and aluminum:0.0001-0.01 weight %. The remainder is the copper alloy which consists of copper and an unescapable impurity substantially, and the content [of the grain size of deposit nickel2Si] of S as 10nm or less and an unescapable impurity is 10 ppm or less.
[Claim 2] Ca: The copper alloy in which washing is [excelling in the solder adhesion according to claim 1 and metal-plating nature which are characterized by containing 0.0001 to 0.0005 weight %] easy.
[Claim 3] Sn: The manufacture method of the copper alloy in which washing is [excelling in the solder adhesion according to claim 2 and metal-plating nature which are characterized by containing 0.2 to 2.0 weight %] easy.
[Claim 4] The copper alloy in which washing is [excelling in the solder adhesion according to claim 1 to 3 and metal-plating nature which are characterized by the magnitude of the nickel2Si deposit in the above-mentioned copper alloy being controlled by 10nm or less] easy.
[Claim 5] The ingot of the copper alloy of a description is hot-rolled to 15mm in thickness at the temperature of 880-950 degrees C to the above-mentioned Claim 1 -3. After carrying out underwater cooling at the temperature of 700 degrees C and performing facing of rolled stock subsequently, Cold-roll to 1.5mm or less in thickness, consider it as a coil strip, quench to the temperature of 650-950 degrees C after continuous annealing for [for / 5 seconds / -] 5 minutes, carry out solution

treatment to it, and then 1.5mm or less-thick solution treatment material as it is Or the manufacture method of the copper alloy in which washing is [cold-rolling with the rolling reduction of 50% or less, holding in temperature of 450-550 degrees C for for 5 minutes to 5 hours, performing deposit treatment, and excelling in the solder adhesion and metal-plating nature which are characterized by cold-rolling further suitably] easy.

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention has the high intensity a lead frame, a terminal, a connector, for a relay, etc., and high conductivity, and relates to precipitation-hardening [with easy pickling of solder adhesion, metal-plating nature, and metal-plating pretreatment] type a copper alloy and its manufacture method.

[0002]

[Description of the Prior Art] As for the electronic parts a lead frame, a terminal, a connector, for a relay, etc., small size and a weight saving are progressing and the board thickness of the copper alloy ingredient used is also becoming thin. Therefore, it is high intensity and the characteristics of high conductivity are required of a copper alloy.

[0003] On the other hand, to these copper alloy ingredients for electronic parts, although metal plating of Sn, solder, nickel, noble metals (Au, Ag, Pd, etc.), etc. is performed, pickling is performed as the pretreatment. It is required that an oxide film should be easily removed by this pickling. Although the junction methods, such as Sn and solder, are furthermore adopted as the assembly of electronic parts generally, if under the assembly of electronic parts or a finished product is put to an elevated temperature, solder will exfoliate easily. Moreover, in Ag metal plating, if an unusual projection takes place to the metal-plating surface, the problem of junction nature with Si chip deteriorating during the fabrication of a semiconductor will occur.

[0004] As an alloy with which it is satisfied of high intensity and the characteristics of high conductivity, many Cu-nickel-Si system alloys are used. A Cu-nickel-Si system alloy may remain on the surface as smut at the time of pickling, when the diameter of the deposit of nickel2Si becomes big and rough. If it plates without removing this smut, the nonconformity of degrading the adhesion of metal plating will be produced. Therefore, the pickling solution containing the small fluoride of the etching force is used so that smut may not be generated. This pickling solution nickel2Si+2NH4 F-HF+4H2O ->SiF4+2nickel(OH)2+NH4OH+3H2 .... (1)

3SiF4+3H2O=2H2SiF6+H2SiO3 ..... (2)

Although SiF4 produced by ********** is ionized and it is hard to produce smut, pickling time becomes it long that the diameter of a nickel2Si deposit is 10nm or more, and it has the problem that productivity falls.

[0005] Although the Cu-nickel-Si system alloy is conventionally known as an alloy with difficult hot working and Mn, aluminum, and Ca are added as the solution if needed to Mg, Cr, and a pan, if a certain amount is exceeded, an unusual projection will generate these elements in the metal-plating treatment in the middle of a semiconductor assembly.
[0006] While it is made in order that this invention may solve such a conventional technical problem, and harnessing the characteristics of high intensity quantity conductivity which are the features of a Cu-nickel-Si system alloy, It aims at excelling in the solder adhesion and metal-plating nature which have improved the hot working nature, the adhesion of solder, metal-plating nature (an unusual projection is not produced), and pickling nature which are a defect, and offering a copper alloy with easy washing, and its manufacture method.
[0007]
[Means for Solving the Problem] [excel in the solder adhesion of this invention, and metal-plating nature, and / the copper alloy with easy washing] nickel: 0.4-4.0 weight %, Si:0.1-1.0 weight %, Zn : Exceeding 1.0, -2.0 weight %, Cr: 0.0001-0.01 weight %, Mg : 0.0001 to 0.001 weight %, And Mn:0.01-0.1 weight % and aluminum:0.0001-0.01 weight % are contained if needed. The remainder is the copper alloy which consists of copper and an unescapable impurity substantially, and the grain size of deposit nickel2Si is [the content of S as 10nm or less and an unescapable impurity] 10 ppm or less.
[0008] In the above-mentioned architecture, it is good also as architecture containing Ca:0.0001-0.0005 weight %. Furthermore, Sn: It is good also as architecture containing 0.2 to 2.0 weight %. Moreover, in each above-mentioned architecture, it is good also as architecture by which the magnitude of the nickel2Si deposit in a copper alloy is controlled by 10nm or less.
[0009] [moreover, the manufacture method of a copper alloy in which washing is / excelling in the solder adhesion of this invention, and metal-plating nature / easy] The ingot of the copper alloy of each above-mentioned architecture is hot-rolled to 15mm in thickness at the temperature of 880-950 degrees C. After carrying out underwater cooling at the temperature of 700 degrees C and performing facing of rolled stock subsequently, Cold-roll to 1.5mm or less in thickness, consider it as a coil strip, quench to the temperature of 650-950 degrees C after continuous annealing for [for / 5 seconds / -] 5 minutes, carry out solution treatment to it, and then 1.5mm or less-thick solution treatment material as it is Or it cold-rolls with the rolling reduction of 50% or less, and it holds in temperature of 450-550 degrees C for for 5 minutes to 5 hours, deposit treatment is performed, and it is made to cold-roll further suitably.
[0010]
[Function] this invention person found out that survival of the smut at the time of pickling for which the charge of electronic-parts lumber is asked could be controlled by limiting the magnitude of the deposit of nickel2Si, and the content of nickel and Si, as a result of conducting various experiments, in order to solve the above-mentioned problem. By selecting the temperature of 450-550 degrees C, and the deposit processing condition of for [5 minutes] - time 5 hours by the content of nickel and Si, the

adhesion of solder controlled the precipitation amount of nickel2Si from measurement of electric conductivity, and found out the method of solving. Ag metal-plating nature deteriorates as the content of Mg, aluminum, and Ca increases. On the other hand, if these elements are not added, an ingot will embrittle in inside and an elevated-temperature region, and the hot working nature of an ingot will deteriorate. In this invention, the component range of the alloying element which solves both technical problem is found out.

[0011] Below, the Reason for addition of each component of the copper alloy concerning this invention, the Reason for presentation definition, the Reason for magnitude definition of a deposit, and the Reason for definition of manufacture conditions are explained.

[0012] nickel: 0.4 to 4.0-weight % nickel is an element which it is added with Si mentioned later and is contributed to the hardness of a copper alloy, and heat-resistant improvement. That is, nickel raises hardness and a heat-resisting property by forming Si and intermetallic compound nickel2Si. When the content of nickel is less than 0.4 weight %, the effect is small, and if contained exceeding 4.0 weight %, the problem that survival of the smut at the time of pickling increases will produce it while electric conductivity falls. Therefore, a Ni content is made into 0.4 to 4.0 weight %.

[0013] Si: It is the element where Si is added with nickel 0.1 to 1.0weight % and which raises hardness and a heat-resisting property. While the effect is small, and electric conductivity will fall if contained exceeding 1.0 weight % when a Si content is less than 0.1 weight %, survival of the smut at the time of pickling increases, and the adhesion of solder also deteriorates. Therefore, a Si content is made into 0.1 to 1.0 weight %.

[0014] Zn: While Zn raises solder adhesion - 2.0weight % exceeding 1.0 weight %, also raise pickling nature. That is, Zn gives priority to the copper alloy containing Zn over Cu by a heating step, and it spreads and oxidizes on the surface. For this reason, when solder is plated by the surface, formation of a Cu3Sn intermetallic compound alloy layer is controlled. If the intermetallic compound of Cu and Sn is formed, the increase of a hole and solder will exfoliate in the interface of solder and a base material. By Zn's giving priority to the alloy containing Zn rather than Cu on the surface, and being spread, formation of a Cu3Sn intermetallic compound is controlled and exfoliation of solder does not take place, either. Moreover, it becomes the dissolution to a pickling solution is easier for the oxide of Zn formed by a heating step than the oxide of Cu, and easy [the alloy containing Zn] pickling.

[0015] Furthermore, at the time of press punching, Zn shows a lubrication effect, and there is little wear of a metal pattern and it raises a mold life. In addition, it also has the improved effect of migration resistance nature and the whisker-proof nature of Sn metal-plating material. Even if those effects have few Zn contents at 1.0 or less weight % and they contain exceeding 2.0 weight %, while those effects are saturated, electric conductivity and the problem that solder wettability falls produce them. Therefore, a Zn content is made into -2.0 weight % exceeding 1.0 weight %.

[0016] Sn: It is an element which raises the hardness and spring characteristics of an alloy, and as for 0.2 to 2.0-weight % Sn, adding is desirable when using it for the application which thinks these characteristics as important. If the above-mentioned effect of the content of Sn is small at less than

0.2 weight % and it contains Sn exceeding 2.0 weight %, electric conductivity will fall substantially. Therefore, the content of Sn may be 0.2 to 2.0 weight %.

[0017] Cr: Cr is an element which strengthens the grain boundary of an ingot and raises hot working nature 0.0001 to 0.01weight %. However, at less than 0.0001 weight %, the effect has little the content, and if Cr is contained exceeding 0.01 weight %, a molten metal will oxidize and fluidity will deteriorate. Therefore, the content of Cr may be 0.0001 to 0.01 weight %.

[0018] Mg: It is an indispensable element also in order for Mg to raise hot working nature 0.0001 to 0.001weight %. That is, Mg has the operation which fixes in an alloy S mixed unescapable at the time of a raw material or the dissolution, and casting as a MgS compound of a high-melting point. Thereby, the hot working nature of a copper alloy can be raised.

[0019] If the above-mentioned effect has little Mg content less than 0.0001 and it contains exceeding 0.001 weight %, it will produce the eutectic of a low-melt point point, hot working nature deteriorates, and a molten metal oxidizes easily, fluidity nature falls, and a healthy ingot becomes difficult to get. Furthermore in metal-plating treatment, the projection by unusual deposit occurs on the surface of metal plating. Therefore, the content of Mg may be 0.0001 to 0.001 weight %.

[0020] It mixes into an alloy from fireproofing, such as a raw material, a furnace, and a guttering, a fuel, or the atmosphere, and S:10 ppmor less S exists by a compound or an S independent with a metal, and becomes the proximate cause which produces a crack during heating in hot working, or processing. If the content of S exceeds 10 ppm, S will remain as it is and an intercrystalline crack will become easy to produce only heating. Moreover, if S exceeds 10 ppm, an unusual deposit will be carried out on the surface of independent or metal plating as a compound, and it will become easy to generate the projection of metal plating. Therefore, the content of S is regulated to 10 ppm or less.

[0021] Ca: 0.0001 to 0.01-weight % Ca is effective in raising the hot working nature of a copper alloy. The effect has few Ca contents less than 0.0001, and if contained exceeding 0.01 weight %, it will remain in an ingot and a healthy ingot will become difficult to get. Therefore, the content of Ca may be 0.0001 to 0.01 weight %.

[0022] Mn: 0.01-0.1 weight %, aluminum: If Mn is an element which raises hot working nature, and the effect has little content of Mn less than 0.01 and Mn contains exceeding 0.1 weight % in addition to the component of the 0.0001 - 0.01 weight % above-mentioned, the fluidity nature at the time of casting will deteriorate. The ingot making yield falls.

[0023] aluminum has the operation which removes S mixed unescapable at the time of dissolution casting as aluminum2S3 out of an alloy. For this reason, by making aluminum contain beforehand, S which is an unescapable impurity can be removed as aluminum2S3 compound, 10 ppm or less can be made to be able to reduce the amount of S, and hot working nature can be raised. Moreover, since aluminum2S3 have light specific gravity, they surface easily in the molten metal upper part at the time of the dissolution. For this reason, the obtained ingot becomes what does not contain aluminum2S3, and the healthy ingot which the unusual projection on the surface of metal plating does not produce is obtained.

[0024] Therefore, Mn:0.01-0.1 weight % and aluminum:0.0001-0.01 weight % are made to contain if needed.
[0025] In addition, they are Co, Fe, and Ti in addition to Cu for the above-mentioned component and Motonari, Even if it contains one sort of Zr, P, V, Nb, Mo, and Ag and W, or two sorts or more to 0.1 weight % in the total amount, characteristics, such as solder adhesion concerning this invention, metal-plating nature, pickling nature, and high tensile, quantity conductivity, are not spoiled. Therefore, inclusion of these components in above-mentioned within the limits is permitted.
[0026] Moreover, as an unescapable impurity, C, Sb, Pb, MM (misch metal), etc. are mentioned.
[0027] Magnitude of a nickel2Si deposit: The hardness of a copper alloy can be raised by making Cu matrix distribute a 10nmor less nickel2Si deposit uniformly minutely. This effect serves as size, so that the distance between grains of a deposit is small. Therefore, for the improvement in hardness of a copper alloy, it is necessary to make distance between grains small. It is possible by making the deposit particle number of nickel2Si increase without making the content of nickel and Si increase from a steady value to make distance between grains small.
[0028] While restricting the content of nickel and Si as mentioned above and making Zn contain, it can lower by restricting the magnitude of a nickel2Si deposit to a marginal level required to secure reliability, such as smut ullage at the time of pickling, and metal-plating adhesion.
[0029] If the magnitude of the deposit of nickel2Si exceeds 10nm, the above-mentioned effect will become small by the time which dissolution takes increasing etc. Therefore, the magnitude of a nickel2Si deposit shall be 10nm or less.
[0030] The Reason for definition of manufacture conditions is explained below.
[0031] Solution-treatment temperature, time: The deposit of the above-mentioned nickel2Si means the thing of a nickel2Si phase which deposits from a host phase by deposit treatment of an ingredient in which cold working was performed after that by solution treatment while nickel and Si which dissolved had been in a dissolution condition for 650-950 degrees C and 5 seconds - for 5 minutes. nickel2Si which is an event of a solution treatment being completed and already exists on the other hand also exists in a final product with nickel2Si which deposited by deposit treatment. nickel2Si which exists in the phase of the ingot before this deposit treatment is considered that crystallized material and a deposit live together. It is crystallized material nickel2Si which remained without these dissolving thoroughly with heating at the time of hot working, and heating of a subsequent solution treatment. Since such nickel2Si of crystallized material has large size, the contribution effect of the improvement in hardness is small, and causes a smut development at the time of pickling. Therefore, when performing casting and hot working, it is desirable to also lessen the amount of the crystallized material which remains after the solution treatment of hot-rolling material as much as possible by controlling a development of the crystallized material at the time of casting, and promoting dissolution of the generated crystallized material in consideration of the heating condition. Then, it cold-rolls to 1.5mm in thickness, and is considered as a coil strip. In order to equalize change of the dissolution condition by the hardening delay of the head after hot-rolling, and the back end, or a crystal grain

diameter, at the temperature of 650-950 degrees C, continuous annealing of the coil strip is carried out for [for / 5 seconds / -] 5 minutes, it is quenched, and a solution treatment is carried out. At this time, the high intensity by the uniform detailed nickel2Si deposit which nickel and Si do not dissolve uniformly but deposits at a next deposit treatment process is not obtained at less than 650 degrees C.

[0032] Since dissolution of the crystallized material of big and rough nickel2Si generated in the crystallized material of big and rough nickel2Si generated in the coagulation process at the time of casting or the cooling process after dissolution-izing is not fully performed, it becomes difficult for a nickel2Si deposit to be 10nm or less. On the other hand, when solution-treatment temperature exceeds 950 degrees C, the above-mentioned effect is not only saturated, but in order that a grain may become big and rough by the secondary recrystallization, the crystal grain diameter at this event remains in a product as it is, a grain boundary becomes weak, deterioration of bending nature, lowering of fatigue strength, and lowering of an impact resistance value are imitated, and it is **. Therefore, solution-treatment temperature shall be 650-950 degrees C.

[0033] Moreover, as for dissolution, under for 5 seconds is [solution-treatment time] inadequate. On the other hand, if solution-treatment time exceeds for 5 minutes, dissolution will be saturated, the improved effect of the hardness by the crystallized material of nickel2Si in subsequent deposit treatment cannot be expected any more, but Ross of energy and productivity becomes large. Therefore, solution-treatment time is carried out for [for / 5 seconds / -] 5 minutes.

[0034] Although the effect of precipitation hardening by subsequent aging treatment is heightened further, the cold rolling after a solution treatment can also be omitted when it gives priority to bending nature.

[0035] Deposit treatment temperature, time: 5-hour deposit treatment for 450-550 degrees C and 5 minutes - is for obtaining precipitation hardening by setting to nickel2Si nickel and Si which dissolved by the solution treatment, and depositing them uniformly minutely in Cu host phase. When deposit treatment temperature is less than 450 degrees C, there are few amounts of a deposit and sufficient hardness cannot be obtained. Moreover, while the hardness of the desired end will not be obtained since big-and-rough-izing and re-dissolution of a deposit take place if deposit treatment temperature exceeds 550 degrees C, the smut survival at the time of pickling and exfoliation of the solder of soldering material take place. Therefore, deposit treatment temperature needs to consider it as 450-550 degrees C.

[0036] Moreover, when the temperature retention time in deposit treatment is under for 5 minutes, there are few amounts of a deposit and the above-mentioned effect cannot fully be acquired. On the other hand, since the above-mentioned effect is saturated even if it exceeds 5 hours, Ross of energy and productivity becomes large. Therefore, temperature retention time in deposit treatment is made into for [5 minutes] - 5 hours.

[0037] Furthermore, it is the object which raises hardness further after deposit treatment, and cold-rolling suitably is possible. It can also omit, when it gives priority to bending nature.

[0038] The cooling rate after a solution treatment: The cooling rate after heating and maintenance is so good for it that it is large to solution-treatment temperature in order to fully perform dissolution-ization. Since the deposit whose velocity is big and rough in less than 10 degrees C/[in a second] at the elevated-temperature side of a cooling process is formed, the hardness improved effect of the desired end is not not only acquired by subsequent deposit treatment, but the nonconformity that a big and rough deposit remains as smut at the time of pickling arises. Therefore, the cooling rate after a solution treatment is carried out in 10 degrees C/[a second and] or more.

[0039]

[Example] The molten metal which dissolved and ingoted in the air the copper alloy of the presentation shown in the following table 1 under the charcoal coat using the high frequency fusion furnace was cast to the mold made from carbon, and the ingot 50mm in thickness, 80mm in width, and 180mm in length was obtained. Then, the crack of the surface of this ingot was picked and it hot-rolled to 15mm in thickness after heating at 950 degrees C, and from the temperature of 750 degrees C or more, it was immersed underwater and quenched.

[0040] Next, after removing the scale of the surface of each rolled stock etc., cold rolling was performed and the 0.20mm plate was obtained. Then, after immersing these plates for 30 seconds into the salt bath adjusted to the temperature of 750 degrees C and performing a solution treatment, it was immersed underwater and quenched. Then, these plates were cold-rolled, it was considered as the 0.15mm plate, these were heated at the temperature of 500 degrees C for 2 hours, and deposit treatment was performed.

[0041] The following checks were done in order to evaluate the elevated-temperature Charpy impact test of an ingot, the tensile test of a plate, hardness and electric conductivity measurement, the friction test of solder, metal-plating nature, and pickling nature to the ingot and plate which were manufactured as mentioned above.

[0042] A part of ingot was cut and the Charpy impact test at 600 degrees C and 900 degrees C was done according to JIS-Z-2242. After carrying out electrolytic degreasing of the specimen 10mm in width, and 20mm in length in an alkaline-degreasing bath to a plate, assessment of the adhesion of solder, metal-plating nature, and pickling nature was presented.

[0043] After assessment of the adhesion of solder performed 10 micrometers of solder metal plating of 9Sn/1Pb, it was bent 180 degrees after heating maintenance and by 0.5mm of bend radii at the temperature of 150 degrees C till 1000 hours, and observed the existence of exfoliation of the solder after return.

[0044] After carrying out Ag metal plating of the assessment of metal-plating nature in a cyanogen bath, Ag metal-plating surface was observed with the optical microscope of one 100 times the magnification of this, and magnitude observed the existence of the projection by the unusual deposit of Ag of 10 micrometers or more.

[0045] The conditions of Ag metal plating are as follows.

[0046] Cu ground plating-bath presentation: CuCN 42g/l, KCN The degree of 91g/l bath temperature:

60 degrees C, current density:5 A/dm2, thickness:0.1micromAg plating bath presentation:S-930 (made by N.E. Chemcat)

The degree of bath temperature: Assessment of 60 degrees C and current density:50 A/dm2 pickling nature is a thing supposing heating which the lead frame material in inside receives like the assembler of IC, and was performed by the smut ullage after pickling of the ingredient which performed heating for 30 minutes at the temperature of 200 degrees C in the air. The ingredient by which the oxide was formed in these surfaces was immersed for 5 to 20 seconds into the liquid which heated the aqueous solution of NH4 F-HF at 50 degrees C 30 weight % H2SO4 +5weight %. The gravimetry before and behind desmutting with a brush estimated the smut ullage generated at this time.

[0047] The above evaluation result is shown in Table 2. At 600 degrees C, the solution treatment of alloy No.8 of a comparative example is carried out, they are quenched, at 980 degrees C, the solution treatment of No.13 is carried out and they are quenched. Moreover, alloy No.10 of a comparative example carry out deposit treatment at 420 degrees C, and No.13 and 14 carry out deposit treatment at 580 degrees C.

[0048]

[Table 1]

	No.	化学成分 (wt.%)									
		Cu	Ni	Si	Zn	Sn	S	Cr	Mg	その他	
実施例	1	残部	0.40	0.10	1.50	2.0	0.001	0.001	0.0001	—	—
	2	残部	1.00	0.22	1.25	1.0	0.0005	0.0005	0.001	—	—
	3	残部	1.59	0.35	1.05	0.2	0.001	0.0008	0.0006	—	—
	4	残部	1.82	0.40	1.01	—	0.0008	0.001	0.0005	Mn 0.01	—
	5	残部	3.20	0.70	1.05	—	0.001	0.01	0.0008	Al 0.0005	—
	6	残部	3.98	0.91	1.98	—	0.0006	0.008	0.001	Mn 0.01	Al 0.0002
比較例	7	残部	0.30	0.05	—	—	0.0006	—	0.0005	—	—
	8	残部	4.50	1.50	—	—	0.001	—	0.001	—	—
	9	残部	3.20	0.75	—	—	0.002	—	0.005	—	—
	10	残部	3.20	0.72	—	—	0.0025	0.005	0.003	—	—
	11	残部	3.20	0.76	—	—	0.0015	—	—	—	—
	12	残部	3.85	0.81	—	—	0.002	—	—	—	—
	13	残部	1.85	0.42	2.50	—	0.001	0.005	0.002	—	—
	14	残部	1.86	0.43	—	2.2	0.001	0.001	0.01	—	—

[0049]

[Table 2]

	No.	鋳塊の中高温シャルピー衝撃値 kgf·m/cm² 600℃	900℃	熱間圧延性 割れの有無	圧延材の特性 はんだの密着性 150℃, 1000時間後	Agめっき性 Ag突起	酸洗浄性 スマット残存量 mg/cm²	引張強さ kgf/mm²	伸び %	硬さ Hv	導電率 %IACS
実施例	1	5.0	10.2	割れ無・良好	剥離無・良好	無・良好	0.01以下	63.8	14	191	32
	2	3.5	9.5	割れ無・良好	剥離無・良好	無・良好	0.01以下	62.5	15	189	45
	3	2.5	8.2	割れ無・良好	剥離無・良好	無・良好	0.01以下	64.2	16	195	51
	4	2.3	7.8	割れ無・良好	剥離無・良好	無・良好	0.01以下	66.8	15	198	50
	5	2.1	7.5	割れ無・良好	剥離無・良好	無・良好	0.01以下	66.3	12	267	45
	6	2.0	7.2	割れ無・良好	剥離無・良好	無・良好	0.01以下	69.2	12	285	40
比較例	7	4.7	9.5	割れ無・良好	剥離	無・良好	0.01以下	42.0	15	128	65
	8	2.1	8.2	割れ無・良好	剥離	無・良好	0.07	68.5	12	207	30
	9	2.0	6.7	小さな耳割れ	剥離	突起発生	0.01以下	65.8	12	258	45
	10	1.1	5.8	割れ無・良好	剥離	突起発生	0.12	65.2	11	190	32
	11	0.8	1.6	割れ大	—	—	—	—	—	—	—
	12	0.5	1.3	割れ大	—	—	—	—	—	—	—
	13	2.1	8.3	耳割れ発生	剥離無・良好	突起発生	0.15	51.8	10	152	42
	14	2.5	8.6	耳割れ発生	剥離	突起発生	0.08	71.5	12	215	30

[0050] While alloy No.1-6 of this example have a high Charpy impact value in the crown temperature range of an ingot and a plate has high tensile strength and hardness, it turns out that it has good electric conductivity and excels in the adhesion of solder, metal-plating nature, and pickling nature.

[0051] On the other hand, alloy No.7 of a comparative example with little content of nickel and Si run short of hardness. On the other hand, although hardness is excellent, alloy No.8 of a comparative example with much content of nickel and Si have much smut ullage at the time of pickling, and its electric conductivity is also low. Alloy No.9 of a comparative example and 10 have more S and Mg than a regulation value, and are inferior in metal-plating nature. No.11 and 12 had the low Charpy impact value in the crown temperature range, and hot-rolling of them was not completed.

[0052]

[Effect of the Invention] As explained above, according to this invention, the effect that becomes possible [improving hot working nature, the adhesion of solder metal-plating nature, and pickling nature], and the reliability as a charge of electronic-parts lumber improves is large, maintaining the high intensity of the conventional Cu-nickel-Si system alloy, and high conductivity.

[Translation done.]